MINIMUM STANDARD 3.15

MANUFACTURED BMP SYSTEMS

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LIST OF ILLUSTRATIONS

MINIMUM STANDARD 3.15

MANUFACTURED BMP SYSTEMS

The Manufactured BMP Systems presented in this standard have been presented to the Virginia Department of Conservation and Recreation (DCR) by industry manufacturers. DCR acknowledges that there may be additional Manufactured BMP Systems available at this time that are not presented in this handbook. Presentation of the following products does not preclude the use of other available systems, nor does it constitute endorsement of any one system. Additional BMP systems will be presented in Technical Bulletins as they become available.

Definition

A Manufactured BMP system is a structural measure which is specifically designed and sized by the manufacturer to intercept stormwater runoff and prevent the transfer of pollutants downstream.

Purpose

Manufactured BMP systems are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible. These are flow-through structures in that the design rate of flow into the structure is regulated by the inflow pipe or structure hydraulics as opposed to traditional BMPs designed to store the entire water quality volume. When the maximum design inflow is exceeded, the excess flow bypasses the structure or flows through the structure and bypasses the treatment with minimal turbulence and resuspension of previously trapped pollutants. Structures that rely on the inflow pipe to regulate the rate of flow into the treatment chamber typically cause stormwater to back up into the upstream conveyance system or associated storage facility. Depending on the type of structure and the configuration of the conveyance system, this excess flow will either bypass the treatment chamber or be attenuated and allowed to flow through the treatment chamber at the regulated rate.

Pollutant removal efficiencies presented in this standard are based upon currently available studies. Removal efficiencies are very variable, however, and highly dependant on storm size, influent pollutant concentrations, and rainfall intensity. Several monitoring studies are ongoing and many products may be modified to improve pollutant removal performance. Therefore, the removal efficiencies presented may be subject to change. As more of these products are built and additional monitoring studies track their performance over a wide range of rainfall events, the anticipated performance of these systems as water quality BMPs will become better established.

The discussion of each of the manufactured BMP systems presented in this standard includes the target pollutants for which the BMP was designed. Many of these systems were developed to remove a specific range of particulate pollutants, or total suspended solids (TSS), from stormwater runoff. Others, such as the filtering structures discussed below, were developed to capture a broad range of pollutants. The use of phosphorus as the target or “keystone” pollutant is recommended when using the *performance-based* water quality criteria to select a BMP. However, for stormwater “hot-spots”, or areas from which a high concentration of urban pollutants can be expected, the primary pollutant of concern may be hydrocarbons (oil and grease), metals, or other compounds besides nutrients. Manufactured BMPs generally provide effective spill containment for material handling and transfer areas such as automobile fuel and service areas, and other urban hot-spots. Careful analysis of the proposed development project and intended uses help in selecting and appropriate BMP.

The manufactured BMP systems which have been evaluated at this time can be categorized as either:

- **Hydrodynamic Structures** - (*Stormceptor, Vortechs Stormwater Treatment System, Downstream defender, BaySaver Separation System*)
- **Filtering Structures** - (*StormFilter, StormTreat System*)

Hydrodynamic Structures

Hydrodynamic structures are those which rely on settling or separation of pollutants from the runoff. The hydrodynamic structures can be generally categorized as Chambered Separation Structures or Swirl Concentration Structures.

<u>Chambered Separation Structures</u> rely on settling of particles and, to a lesser degree, centrifugal forces to remove pollutants from stormwater. These structures contain an upper bypass chamber and a lower storage/separation chamber. Flow enters the structure in the upper bypass chamber and is channeled through a downpipe into the lower storage/separation, or treatment, chamber. The downpipe is configured such that when the rate of inflow into the structure exceeds its operating capacity, the flow simply “jumps” over the downpipe, bypassing the lower treatment chamber.

The outlet configuration of the downpipe forces the water to enter the lower treatment chamber in one direction, which encourages circular flow. This circular flow, as well as gravitational settling, traps the sediments and other particulate pollutants (as well as any pollutants which adsorb to the particulates) at the bottom of the chamber. The water leaves the treatment chamber through a return or riser pipe. The return or riser pipe extends below the water surface within the lower treatment chamber in order to prevent trapped floatables from exiting the structure. The hydraulic gradient of the structure prevents the inflow and the discharge from creating turbulent conditions within the lower treatment chamber. This feature helps prevent the resuspension of previously trapped particulate pollutants during high flow, or “bypass”, storm events.

Swirl Separation Structures are characterized by an internal component that creates a swirling motion. This is typically accomplished by a tangential inflow location within a cylindrical chamber. The "swirl" technology is similar, if not identical to, the technology used in treating combined sewer overflows. The solids settle to the bottom and are trapped by the swirling flow path. Additional compartments or chambers act to trap oil and other floatables.

There is no bypass for larger flows prior to the treatment or swirl chamber. The larger flows simply pass through the structure untreated. However, due to the swirling motion within the structure, larger flows do not resuspend previously trapped particulates.

Filtering Structures

Filtering structures are characterized by a sedimentation chamber and a filtering chamber. The manufactured systems presented in this standard, the *StormFilter* and the *StormTreat System*, use very different configurations and filtering media. Both contain a primary settling chamber to remove heavy solids, floatables, oil, etc. The *StormTreat System* then directs the water through a series of screens and geotextile filters and into a containerized wetland system with soil and aquatic plants. The *StormFilter*, on the other hand, uses any one or combination of filter media cartridges. The filter media selected is typically based on the target pollutants to be removed or the desired efficiency. The number of cartridges is dependent on the project size, desired removal efficiency, and peak flow rates.

These categories represent the general groupings of manufactured systems that have been presented to DCR to date. More systems may be added in the future as they become available.

TABLE 3.15-1
Pollutant Removal Efficiencies for Manufactured BMPs

Type	Target Phosphorus Removal Efficiency*
Hydrodynamic Structures (*Stormceptor, Vortechs, Downstream Defender, BaySaver*)	15% - 20%
Filtering Structures (*StormFilter, StormTreat System*)	50%

*Pollutant removal efficiencies are subject to change pending monitoring results.

Conditions Where Practice Applies

Drainage Area

The sizing criteria for each manufactured BMP system should be obtained from the manufacturer to insure that the latest design and sizing criteria is used. In general, the flow-through configuration and treatment limitations will force drainage areas to remain relatively small.

Development Conditions

Manufactured BMP systems are ideal for use in ultra-urban areas since they are space efficient. Most of these systems can be placed under parking lots, or simply installed as a manhole junction box or inlet structure. Since other BMPs, such as sand filters and bioretention structures, are also suited for urban development, the designer must consider the type of pollutant load anticipated from the site, as well as other site factors, such as maintenance, aesthetics, etc., and select an appropriate BMP. In general, hydrodynamic are recommended for the following:

- Pretreatment for other BMPs;
- Retrofit of existing development or Redevelopment; and
- Ultra-urban development areas.

Filtering structures are generally recommended for use in applications similar to General Intermittent Sand Filters (**Minimum Standard 3.12**) and Bioretention Filters (**Minimum Standard 3.11**).

In all cases, Manufactured BMP systems must be designed in accordance with the manufacturers specifications.

Planning Considerations

The most significant feature of manufactured BMP systems is their small size and the ability to use them as retrofits underneath improved areas. (It should be noted that other BMPs, such as sand filters, can also be placed under improved areas.) The fact these BMPs are underground requires the designer to locate an acceptable outfall or improved drainage system for discharging runoff. The vertical elevation of the inflow and outflow pipe connections may be critical to the choice, or design, of the BMP.

Overflow

All of the manufactured BMP systems presented in this standard are flow-through structures that can be located on storm drainage systems that drain improved areas. Most manufactured systems, however, are designed to treat the first flush, or the water quality volume, of runoff. Therefore, an overflow, or bypass, is needed to divert flow that exceeds the design rate, or a storage facility is needed to store the appropriate volume of runoff for treatment. The discussion of each manufactured system will include the overflow or bypass provisions provided, or required.

Design Criteria

The design criteria for manufactured BMP systems should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is appropriately designed and sized.

Maintenance and Inspections

All manufactured BMP systems require regular inspection and maintenance to maximize their effectiveness. The specific maintenance requirements and schedule should be prepared by the manufacturer and signed by the owner/operator. It should be noted that the frequency of maintenance is not only dependent on the type of manufactured system chosen, but also the pollutant load from the contributing drainage area. The frequency of maintenance required may vary from after any major storm, to once a month, to up to twice a year.

A maintenance log should be required to keep track of routine inspections and maintenance. A maintenance log can also help facility owners establish the effectiveness of certain “housekeeping” practices, such as street sweeping. Failure to maintain any stormwater BMP may result in reduced efficiency, resuspension or mixing of previously trapped pollutants, or clogging of the system.

Many suppliers of manufactured BMP systems recommend service contracts to ensure that maintenance occurs on a regular basis. Lack of maintenance is widely acknowledged to be the most prevalent cause of failure of both structural and non-structural BMPs.

Another consideration with manufactured BMP systems is the possible contamination and toxicity of trapped sediments, especially in areas considered to be stormwater hot-spots. Care must be taken in the disposal of sediment that may contain accumulations of heavy metals. Sediment testing is recommended prior to sediment removal to assure proper disposal. Experience in other jurisdictions has indicated a reluctance to on the part of waste water utility operators to accept the pump-out material from these structures. Landowners are encouraged to research the disposal options as part of the planning process prior to selecting the BMP.

MINIMUM STANDARD 3.15A

STORMCEPTOR

Description

Stormceptor is a precast, modular, vertical cylindrical tank, which is divided into an upper bypass chamber and a lower storage/separation chamber. Under normal design flow operating conditions flow enters the structure through the upper chamber and is diverted by a U-shaped weir through a downpipe and into the lower separation/holding, or treatment, chamber. The downward flow is redirected horizontally around the circular walls of the separation chamber by a tee-fitting on the downpipe outlet. This circular flow, as well as gravitational settling, traps sediments and other particulate pollutants (as well as any pollutants which adsorb to the particulates) at the bottom of the chamber.

Water exits the lower chamber through a submerged outlet riser pipe. The bottoms of the inlet downpipe and the outlet riser pipe are submerged and set at the same elevation (the elevation that provides the oil/floatable storage above the pipes, and the solids/sediment storage below the pipes). The submerged outlet riser pipe prevents trapped floatables from exiting the structure. This configuration prevents the inflow and discharge from creating turbulent flow conditions within the lower treatment chamber, thus avoiding resuspension and export of previously trapped pollutants during high flow, or “bypass,” storm events.

There are no moving parts and no external power requirements for the *Stormceptor*.

Overflow – During-high flow periods, stormwater floods over the diversion weir and continues through the upper bypass chamber into the downstream sewer. This rapid activity creates pressure equalization across the bypass chamber, thus decreasing the flow through the lower treatment chamber, and preventing scour and resuspension of previously trapped materials.

Hydraulics – The overflow of the system is controlled by the incoming velocity and the hydraulics of the diversion weir. This system will cause a slight backwater condition in the upstream conveyance system.

Planning Considerations

Stormceptor is precast and comes in various sizes and is designed for all types of land uses. The system is engineered for traffic loading and can be installed as a manhole structure on an existing system (as a retrofit) or on a new system where water quality enhancement is required.

Target Pollutants – *Stormceptor* is designed to capture sediment, total suspended solids (TSS), trash, organic material, and floatable oil and grease. In addition, many other urban pollutants which adsorb to sediments and particulates can also be trapped by the structure.

Design Criteria

The design criteria for the *Stormceptor* should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is appropriately designed and sized.

Maintenance and Construction

It is generally recommended that the system be maintained (full pump-out) once per year. This frequency may have to be adjusted to a shorter interval once loading rates are determined. Regular inspections will help determine the required frequency of cleaning. More frequent inspections are appropriate where oil spills occur regularly. Maintenance is completed using a conventional vacuum truck.

Contact:

Mr. Vince Berg, P.E.
Stormceptor Corporation
600 Jefferson Plaza
Suite 304
Rockville, Maryland 20852
Phone: 1-800-762-4703

FIGURE 3.15-1
Stormceptor - Normal Flow Conditions

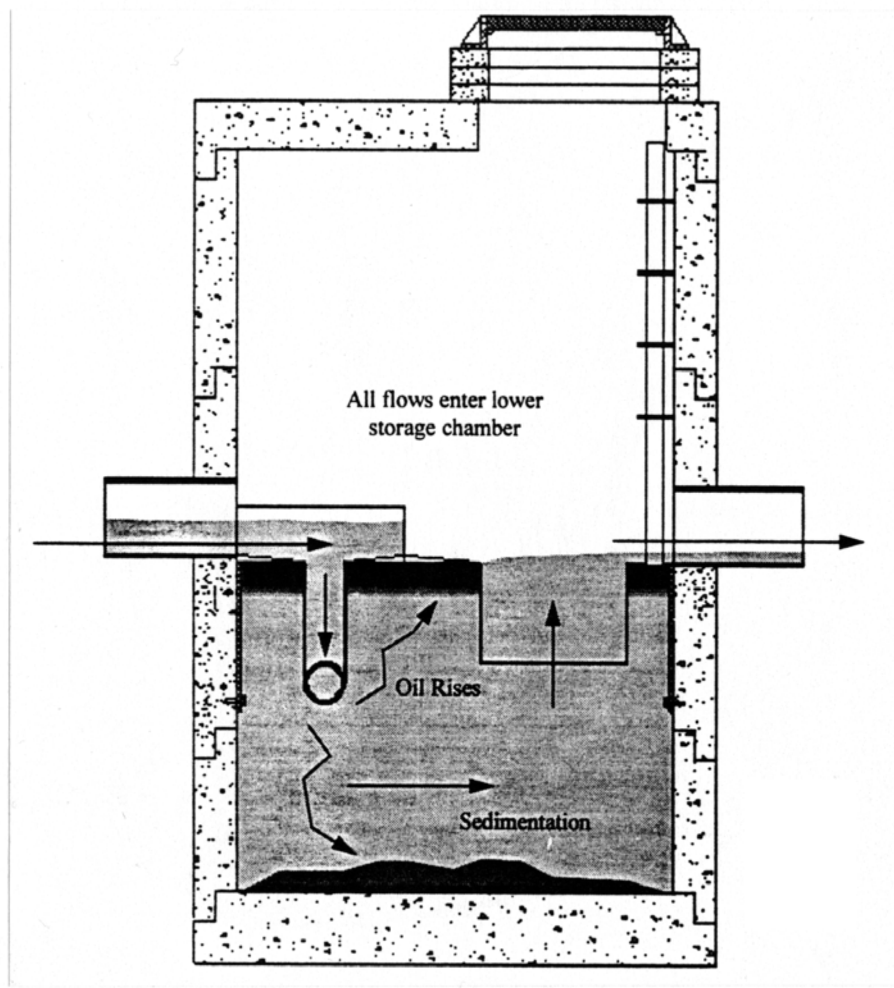
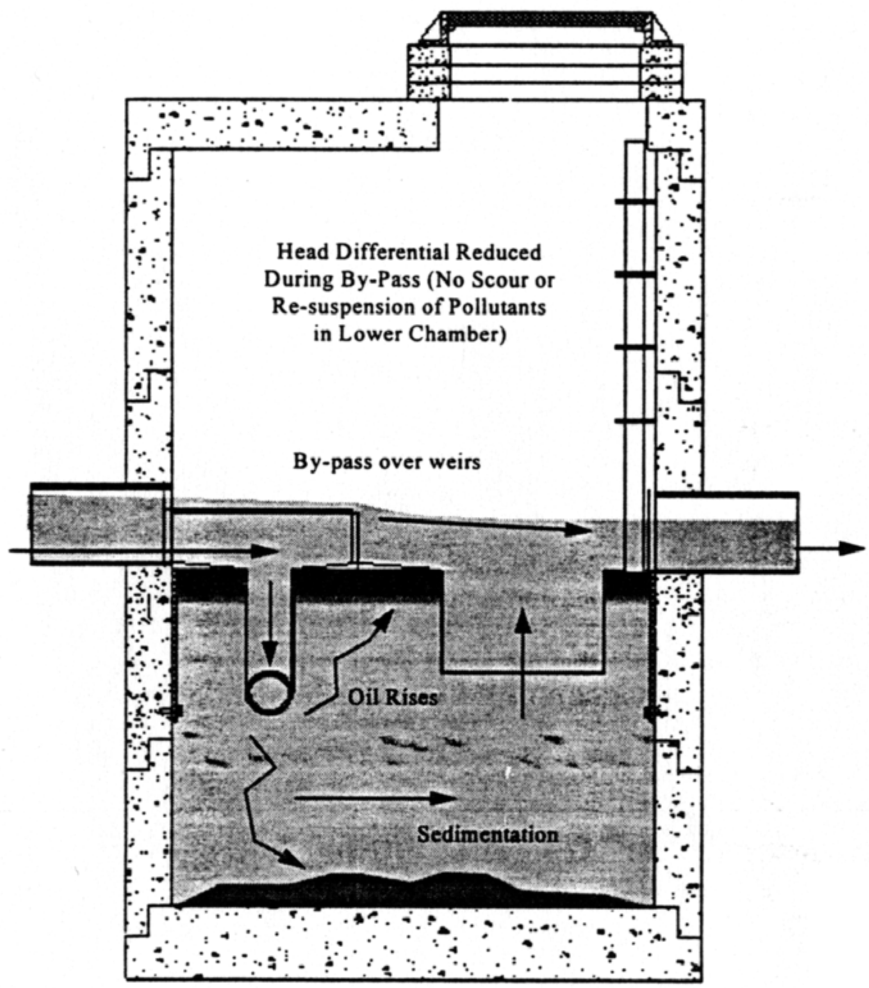


FIGURE 3.15-2
Stormceptor - High Flow Conditions



MINIMUM STANDARD 3.15B

VORTECHS STORMWATER TREATMENT SYSTEM

Description

The *Vortechs Stormwater Treatment System* is a precast rectangular unit with three chambers. The first chamber is referred to as the grit chamber and consists of a 1/4-inch thick aluminum cylinder with openings to release water at a controlled rate. The flow enters this chamber at a tangent to create a swirling motion that directs settlable solids towards the center. The flow is slowly released from the swirl concentrator into the oil chamber. The oil chamber has a barrier which traps oil and grease and other floatables. The final chamber is the flow control chamber, which forces water to back up in the structure, this reducing the inflow velocities and turbulence.

There are no moving parts and no external power requirements for the *Vortechs System.*

Overflow - As the rate of runoff increases, the flow control chamber forces the runoff to fill the *Vortechs* structure. As this occurs, the swirling action in the grit chamber increases, keeping sediments and other material concentrated at the center of the chamber. The flow will back up to a level established by the elevation of the release openings within the overflow chamber. This provides the ability to achieve flow attenuation within the storage capacity of the upstream storm drainage system. If additional flow attenuation or quantity controls are needed, the elevation of the *Vortechs System* can be manipulated to back up water into a detention facility. Because the swirling action increases as the inflow velocity increases, resuspension of previously deposited material during high flows is eliminated.

Hydraulics - The hydraulics of the *Vortechs System* allow for the treatment of runoff from frequent storms as well as the flow from larger, less frequent storms. Larger storms will cause runoff to back up in the drainage system as the storage volume within the structure is above the inflow pipes.

Planning Considerations

The *Vortechs Stormwater Treatment System* is precast and comes in various sizes and is designed for all types of land uses. The system can be engineered for traffic loading, and depending on the invert elevations can be installed on an existing pipe system (as a retrofit) or on a new system where water quality enhancement is required.

Target Pollutants – The *Vortechs System* is designed to capture sediment as fine as clay sized particles, and the nutrients and metals that adhere to sediments. Also targeted are floating materials, including petroleum products.

Design Criteria

The design criteria for the *Vortechs System* should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is correctly designed and sized.

Maintenance and Inspections

The *Vortechs System* has no ongoing maintenance requirements, although routine inspections are necessary to schedule cleaning. To insure proper performance and treatment efficiency, the system must be cleaned out when it is full. The rate at which the system accumulates contaminants is largely dependent upon site activities.

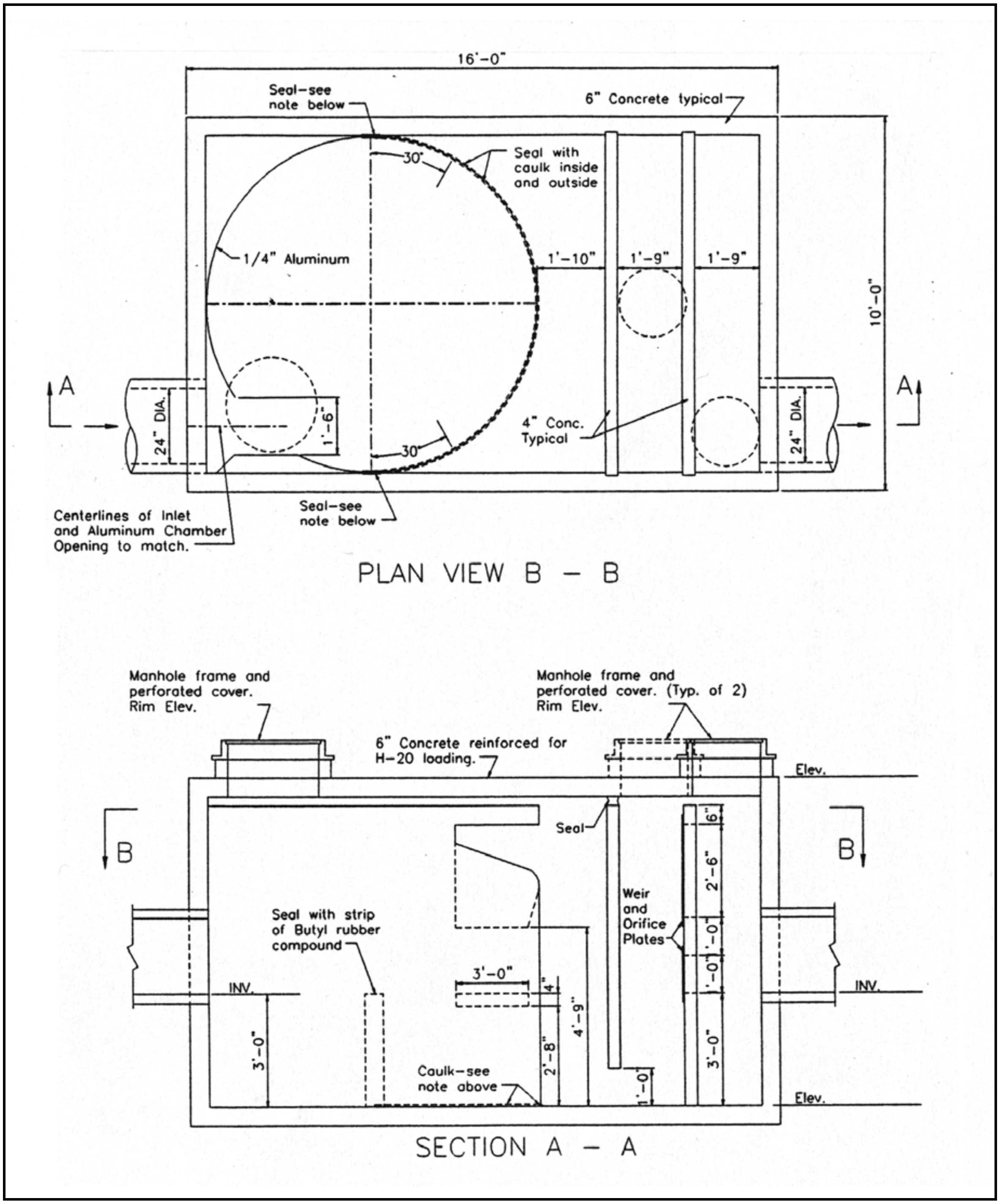
The first year of operation, Vortechnics recommends monthly inspections during periods of heavy contaminant loadings (e.g., winter sanding, soil disturbances, etc.). The inspection schedule can then be modified in subsequent years according to experience.

Clean-out of the *Vortechs System* with a vacuum truck is generally the best and most convenient method. Only the manhole cover above the grit chamber (the one farthest from the system outlet) needs to be opened to remove water and contaminants. As the grit chamber is pumped out, the oil and water drain back into it, so that oil scum, particulates and floatables are removed along with accumulated sediments. A pocket of water between the grit chamber and the flow control chamber seals the bottom of the oil barrier and prevents the loss of floatables to the outlet during cleaning.

Contact:

Tom Adams
Vortechnics
41 Evergreen Drive
Portland, ME 04103-1074
Phone: (207) 878-3662

FIGURE 3.15-3
Vortechs Stormwater Treatment System - Model # 9000



MINIMUM STANDARD 3.15C

DOWNSTREAM DEFENDER

Description

The *Downstream Defender* consists of a concrete cylindrical structure with stainless steel internal components and a internal sloping base. Stormwater runoff enter the structure through a tangential inlet pipe which creates a swirling motion within the structure. The flow spirals down the perimeter of the structure, allowing heavier particles to settle out by gravity and drag forces exerted on the wall and base of the structure.

The base of the *Downstream Defender* is formed at a 30 degree angle. As the flow rotates about the vertical axis, solids are directed towards the base of the structure where they are stored in the collection facility. The steel internal components direct the main flow away from the perimeter and back up the middle of the vessel as a narrower spiraling column rotating at a slower velocity than the outer downward flow.

A dip plate is suspended from the underside of the component support frame. This dip plate serves two purposes: 1) it locates the shear zone, (the interface between the outer downward circulation and the inner upward circulation where a marked difference in velocity encourages solid separation), and 2) it establishes a zone between it and the outer wall where floatables, oil and grease are captured and retained after a storm. When the flow reaches the top of the structure, it is virtually free of solids and is discharged through the outlet pipe.

There are no moving parts and no external power requirements for the *Downstream Defender.*

Overflow - There is no overflow or bypass of larger storms. As the rate of runoff increases, the swirling motion keeps the sediments trapped in the collection facility, thus allowing the full range of storms to pass through the facility with minimum resuspension.

Hydraulics - The outlet flow from the *Downstream Defender* can be regulated with its associated valve, the *Reg-U-Flow Vortex Valve*. The valve can be adjusted to maximize the available storage in the upstream drainage system or upstream detention facility (if additional flow attenuation is required) by reducing the flow and backing the water up in the upstream system.

Planning Considerations

A drop structure upstream of the *Downstream Defender* may be required to ensure that the flow enters into the structure at the appropriate elevation. The *Downstream Defender* comes in various sizes and is designed for all types of land uses. Depending on existing pipe invert elevations it can be installed on an existing pipe system (as a retrofit) or in a new system where water quality enhancement is required.

Target Pollutants – The *Downstream Defender* is designed to capture sediments, and grit (TSS), as well as floatable materials, including petroleum products. In addition, pollutant which adsorb to the particulates can also be trapped.

Design Criteria

The design criteria for the *Downstream Defender* should be obtained from the manufacturer. All designs should be reviewed by the manufacture to insure that the system is correctly designed and sized.

Maintenance and Inspections

A simple sump-vac procedure is periodically required to remove floatables and solids from the *Downstream Defender* collection facility. Regular inspections should be carried out over the first 12 months of operation to determine the rate of sediment and floatables accumulation. A probe may be used after storm events to determine the sediment depth in the collection facility. This information can then be used to establish a maintenance schedule. H.I.L. Technology, Inc. recommends inspection and clean-out at least twice a year.

A standard septic tank hose is not appropriate for the clean-out procedure. A *Vacall* with a 6-inch, or larger, hydraulic hose is required. The *Vacall* is capable of loosening compacted solids by reversing the vacuum pump prior to the sump- vac procedure.

Floatables should be removed prior to emptying the collection facility. The floatables access port is located between the concrete vessel wall and the dip plate. The collection facility access port is located directly over the center shaft.

Contact:

H.I.L. Technologies, Inc.
94 Hutchins Drive
Portland, ME 04102
Phone: 1-800-848-2706

FIGURE 3.15-4
Downstream Defender - Section View

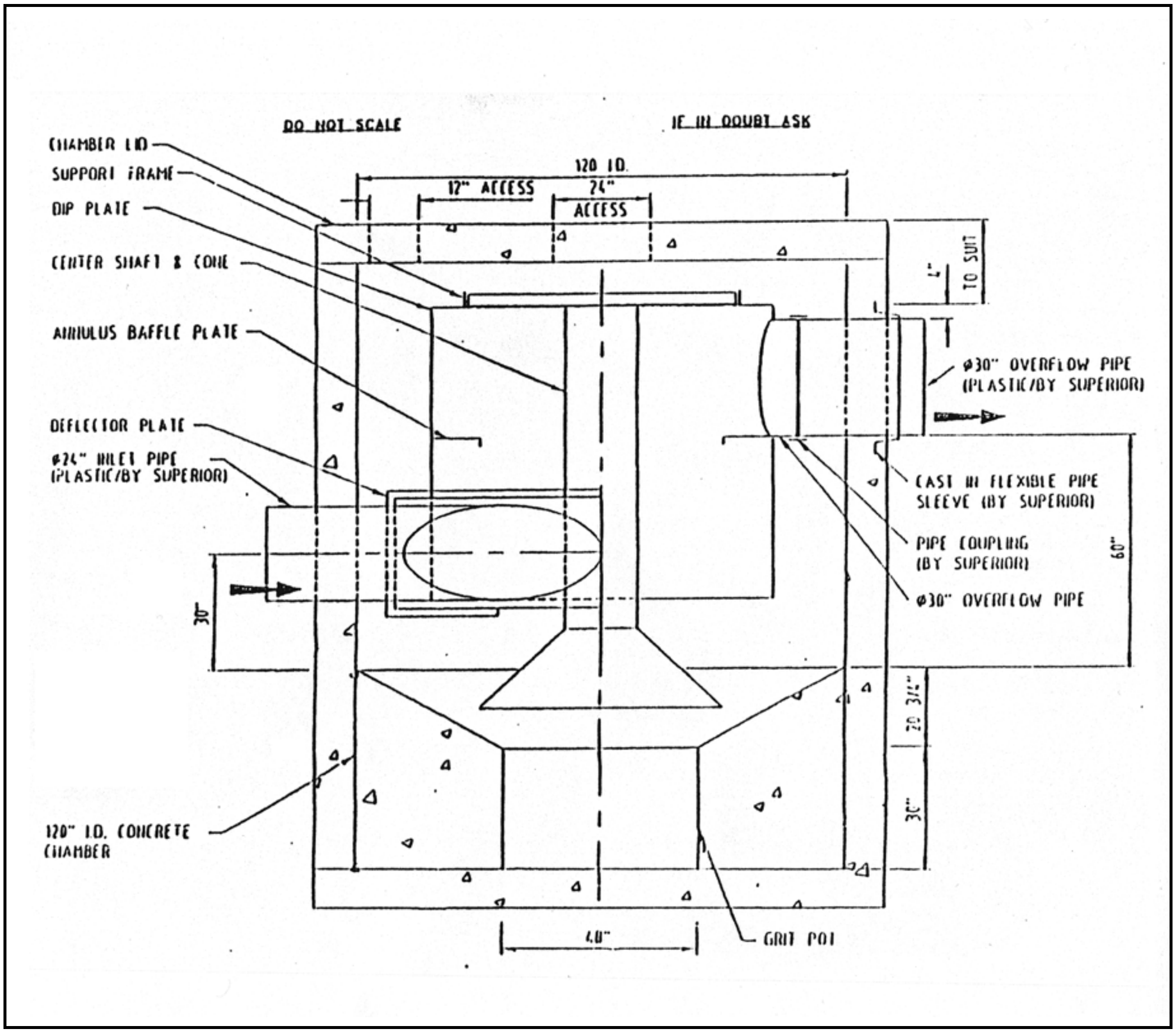
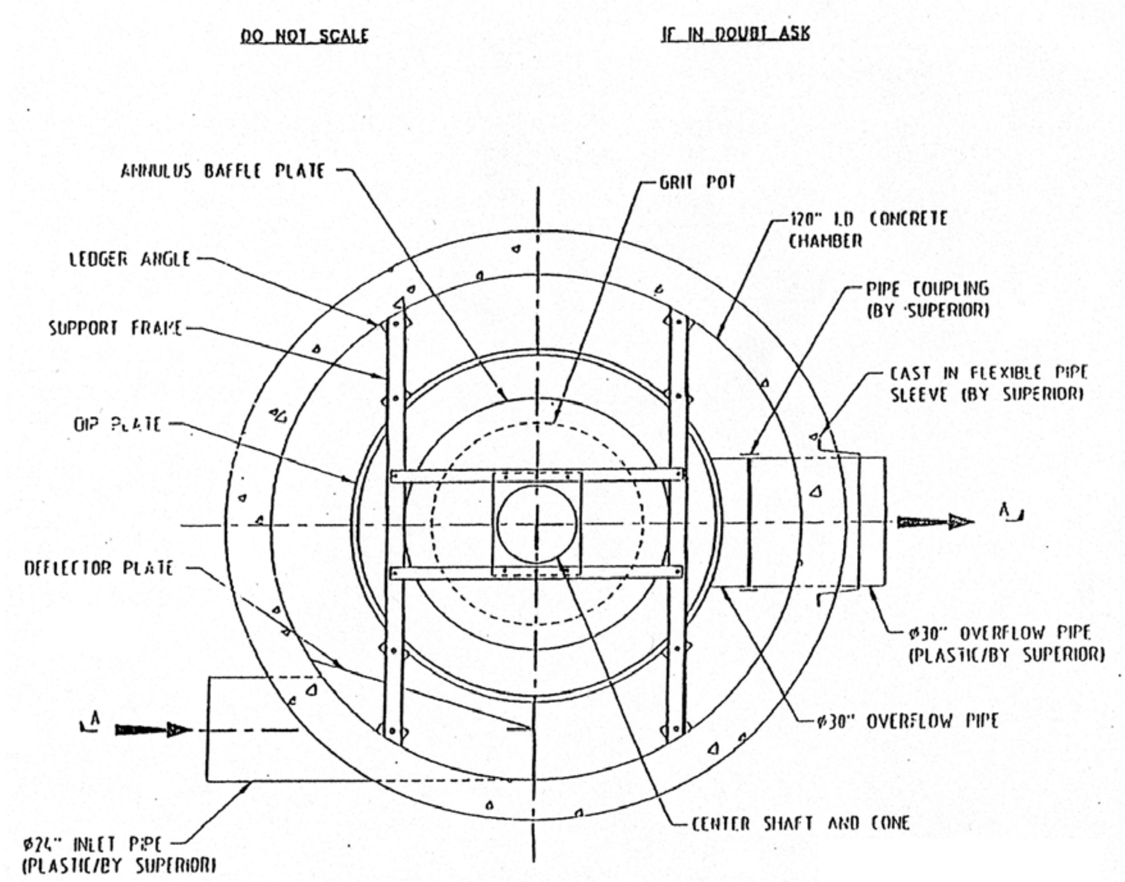


FIGURE 3.15-5
Downstream Defender - Plan View



MINIMUM STANDARD 3.15D

STORMTREAT SYSTEM

Description

The *StormTreat System* captures and treats the first flush of runoff. An optional infiltration feature provides for the treatment of larger quantities of stormwater (beyond the first flush).

The system consists of a series of six sedimentation chambers and a constructed wetland which are contained within a modular 9.5-foot diameter tank. It is constructed of recycled polyethylene, which connects directly to existing drainage structures.

As stormwater enters the system, it is piped into sedimentation chambers where larger-diameter solids are removed. The internal sedimentation chambers contain a series of skimmers which selectively decant the upper portions of the stormwater in the sedimentation basins, leaving behind the more turbid lower waters. The skimmers significantly increase the separation of solids, as compared to conventional settling/detention basins. An inverted elbow trap serves to collect floatables, such as oils, within the inner tank. After moving through the internal chambers, the partially treated stormwater passes into the surrounding constructed wetland through a series of slotted PVC pipes.

The wetland is comprised of a gravel substrate planted with the bulrushes and other wetland plants. Unlike most wetlands constructed for stormwater treatment, the *StormTreat System* conveys stormwater into the subsurface of the wetland and through the root zone, where greater pollutant attenuation occurs through such processes as filtration, absorption, and biochemical reactions.

Precipitation of metals and phosphorus occurs within the wetland substrate, while biochemical reactions, including microbial decomposition, provide treatment of the stormwater prior to discharge through the outlet valve. An outlet control valve provides a variable holding time within the system and can be closed to contain a hazardous waste spill.

There are no moving parts and no external power requirements for the *StormTreat System*.

Overflow - There is no internal, large storm bypass within the *StormTreat System*. An overflow of the treated water is provided and is conveyed to a receiving channel or pipe system, or as option, the overflow can be directed into he surrounding soils for infiltration (if the soils meet the criteria for infiltration facilities - **Minimum Standard 3.10**). This feature can be enhanced by backfilling the excavation around the StormTreat System with 3/4" stone, similar to an infiltration trench with the StormTreat system providing pretreatment.

The flow into the *StormTreat System* is be regulated by the inflow pipe. A storage structure or basin may be used to temporarily hold the runoff until it can drain into the *StormTreat System.*

Hydraulics – The flow through the various filtering mediums is slow and, therefore, the backwater effects are high for this system. Flow through the system is gravity dependent such that a 4-foot difference in elevation is needed from the pavement surface to the discharge point. This may prove difficult on relatively flat sites.

Planning Considerations

The *StormTreat System* can be configured in clusters of tanks to fit within limited areas and is designed for all types of land uses. The manufacturer recommends that a sump catch basin be placed prior to the StormTreat System in order to trap larger diameter sediments.

Target Pollutants – The *StormTreat System* is designed to capture sediment (TSS), fecal coliform bacteria, total petroleum hydrocarbons, total dissolved nitrogen, total phosphorus, lead, chromium, and zinc.

Design Criteria

The design criteria for the *StormTreat System* should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is designed and sized correctly.

Maintenance and Inspections

The *StormTreat System* requires minimal maintenance. Annual inspection is recommended to insure the system is operating effectively. During inspection the manhole should be opened, the burlap grit screening bag covering the influent line should be removed and replaced, and filters should be removed, cleaned, and reinstalled. Sediment should be removed from the system via suction pump once every 3 to 5 years, depending on local soil characteristics and catch basin maintenance practices.

Contact:
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StormTreat Systems Inc.
90 Route 6A
Sextant Hill, Unit 1
Sandwich, MA 02563
ph. (508) 833-1033

FIGURE 3.15-6
StormTreat System Tank

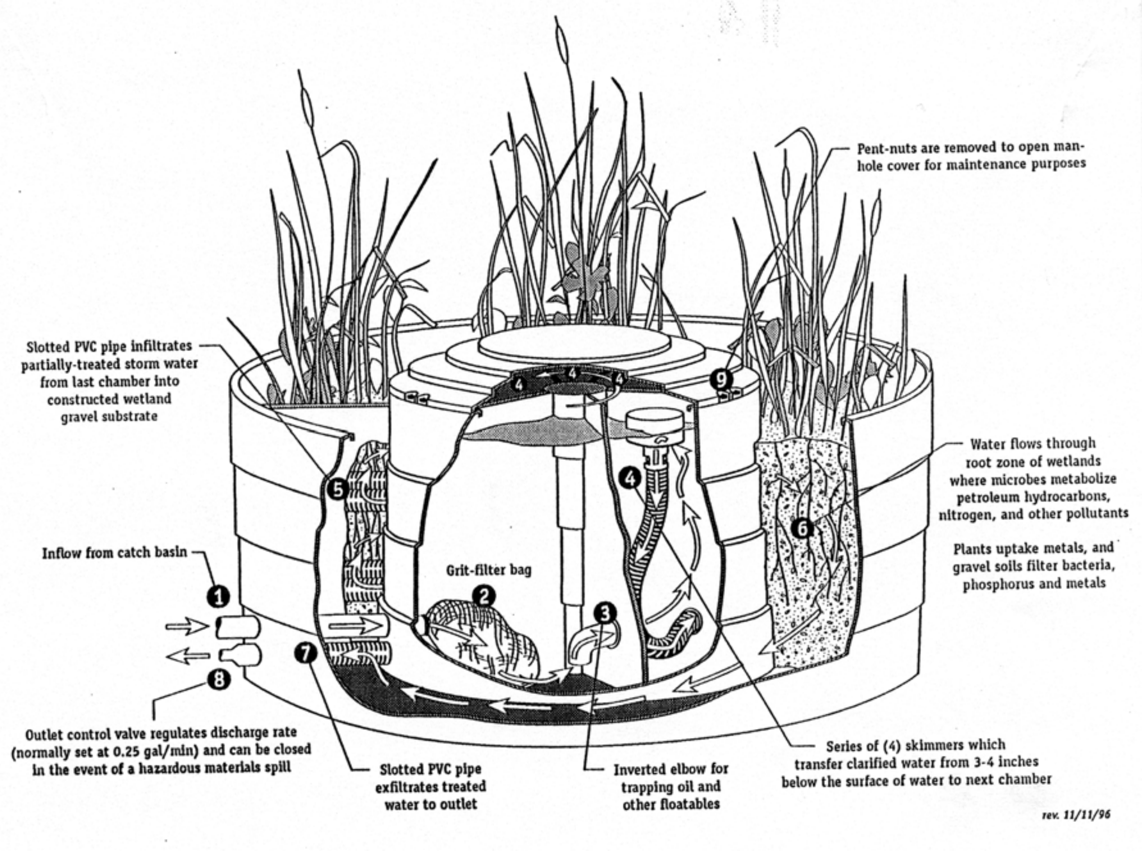
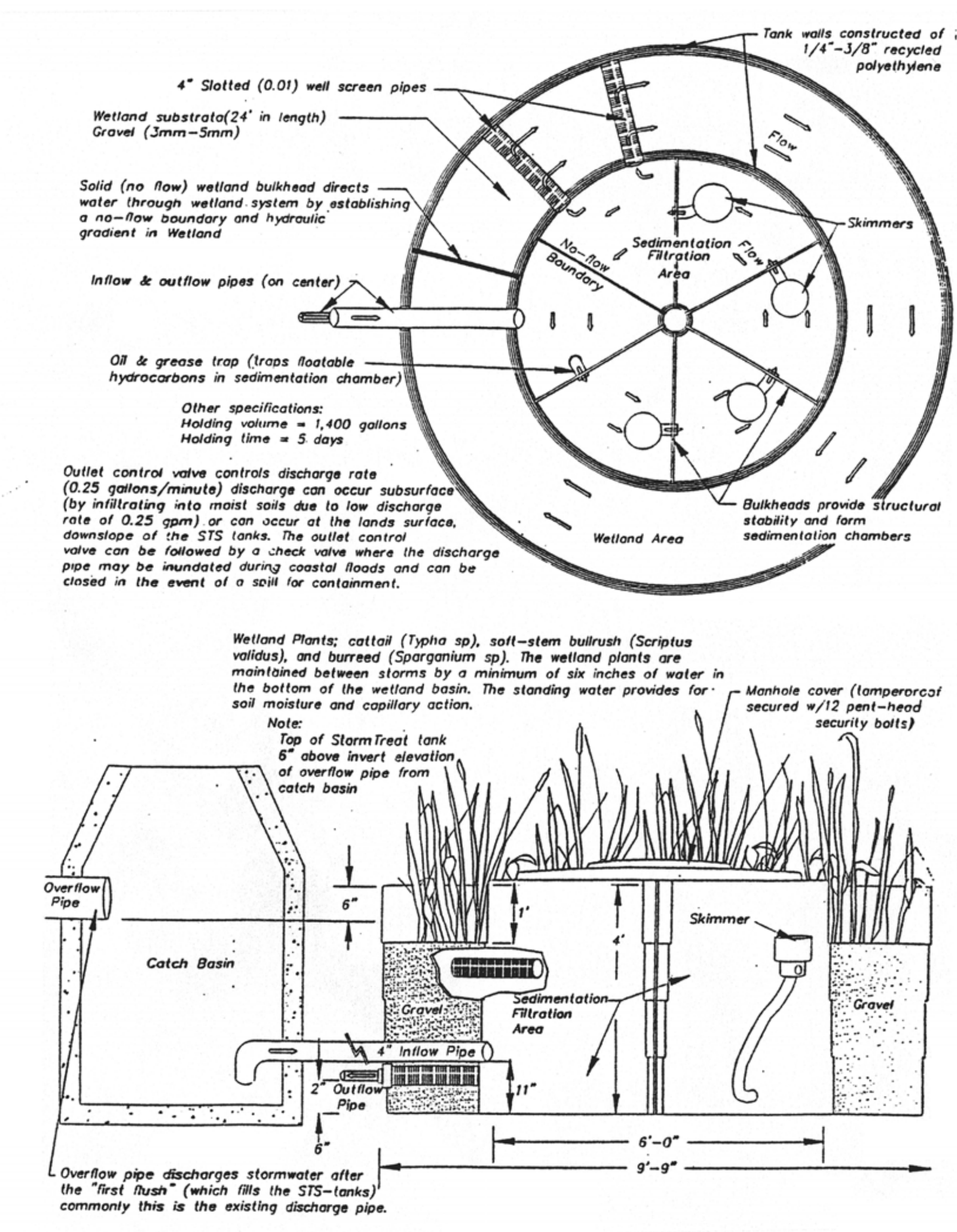


FIGURE 3.15-7
StormTreat System



MINIMUM STANDARD 3.15E

STORMFILTER

Description

The *StormFilter* uses cylindrical rechargeable filter cartridges which hold a variety of filter media and can be customized by using different filter media to remove desired levels of sediments, phosphorus, nitrates, soluble metals, and oil & grease. Housed in standard size pre-cast or cast-in-place concrete vaults, the filter systems can be installed in-line, allowing stormwater to percolate through the cylindrical cartridges before discharging to an open channel drainage way. The *StormFilter* is equipped with scum baffles that trap floating debris and surface films, even during overflow conditions.

There are no external power requirements for the *CSF Stormwater Treatment System*. Moving parts are contained within the filter cartridges as part of the *priming system* discussed in the Hydraulics section.

Overflow – The *CSF system* is designed with an overflow that operates when the inflow rate exceeds the infiltration capacity of the filter media. The overflow consists of a weir wall inside the structure housing. Depending upon individual site characteristics, some filters are equipped with high- and/or low-flow bypasses. High-flow bypasses can be installed when the calculated peak storm event generates a flow which overcomes the overflow capacity of the filter.

Hydraulics – The hydraulics of the *StormFilter* are designed to maintain the design flow rate through the filter without pumps or other motorized devices. Each filter cartridge contains a float-actuated device called a *priming system* within the central drainage tube. This system primes the cartridges, which then develop a siphon inside the drainage tube. The siphon increases as the filter cartridges become progressively clogged to help maintain the design flow.

Planning Considerations

The *StormFilter* is a structural BMP which can be easily installed in a parking lot or in fully developed areas as it does not require additional development space. However, consideration should be given to long term maintenance costs.

Target Pollutants – The *StormFilter* is designed to capture sediment (TSS), soluble metals, and oil and grease, nitrogen, and phosphorus. The various filter media can be selected to target pollutants of primary concern. The following filter media are available:

- Pleated fabric
- CSF leaf media
- Perlite
- Zeolite
- Granular activated carbon

According to the manufacturer, a combination of the pleated fabric and the zeolite media provides the best removal efficiencies for phosphorus and TSS.

Design Criteria

The design criteria for the *CSF Stormwater Treatment System* should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is correctly designed and sized.

Maintenance and Inspections

Maintenance requirements of the *CSF Stormwater Treatment System* are controlled by the amount of plugging of the filters caused by sediment accumulation. The filters are progressively loaded with sediment contained in runoff. At least one scheduled inspection of the filter must be undertaken to perform minor maintenance activities, which includes flow valve adjustment. The major maintenance activity is performed to rejuvenate the media and clean the system. Major maintenance activities may also be required in the event of a chemical spill or excessive sediment loading (due to site erosion or extreme storms). It is also good practice to inspect the system after severe storm events.

When the cartridges become too occluded with sediments, maintenance involves the removal of the exhausted cartridges and replacement with freshly charged cartridges. The time period between when the cartridges are initially installed and when they must be replaced is dependent upon site specific conditions and sediment loading.

As with other filtration systems, sediments will accumulate on the filter surface, eventually slowing the infiltration capacity. To reduce sediment loading to the surface of filters, it is recommended that the filters be used in conjunction with sediment reducing practices such as parking lot sweeping and catch basin sand traps.

Contact:

Mr. James H. Lenhart, P.E.
Stormwater Management
2035 Colombia Boulevard, NE
Portland, Oregon 97211
ph. (800) 548-4667

FIGURE 3.15-8
StormFilter

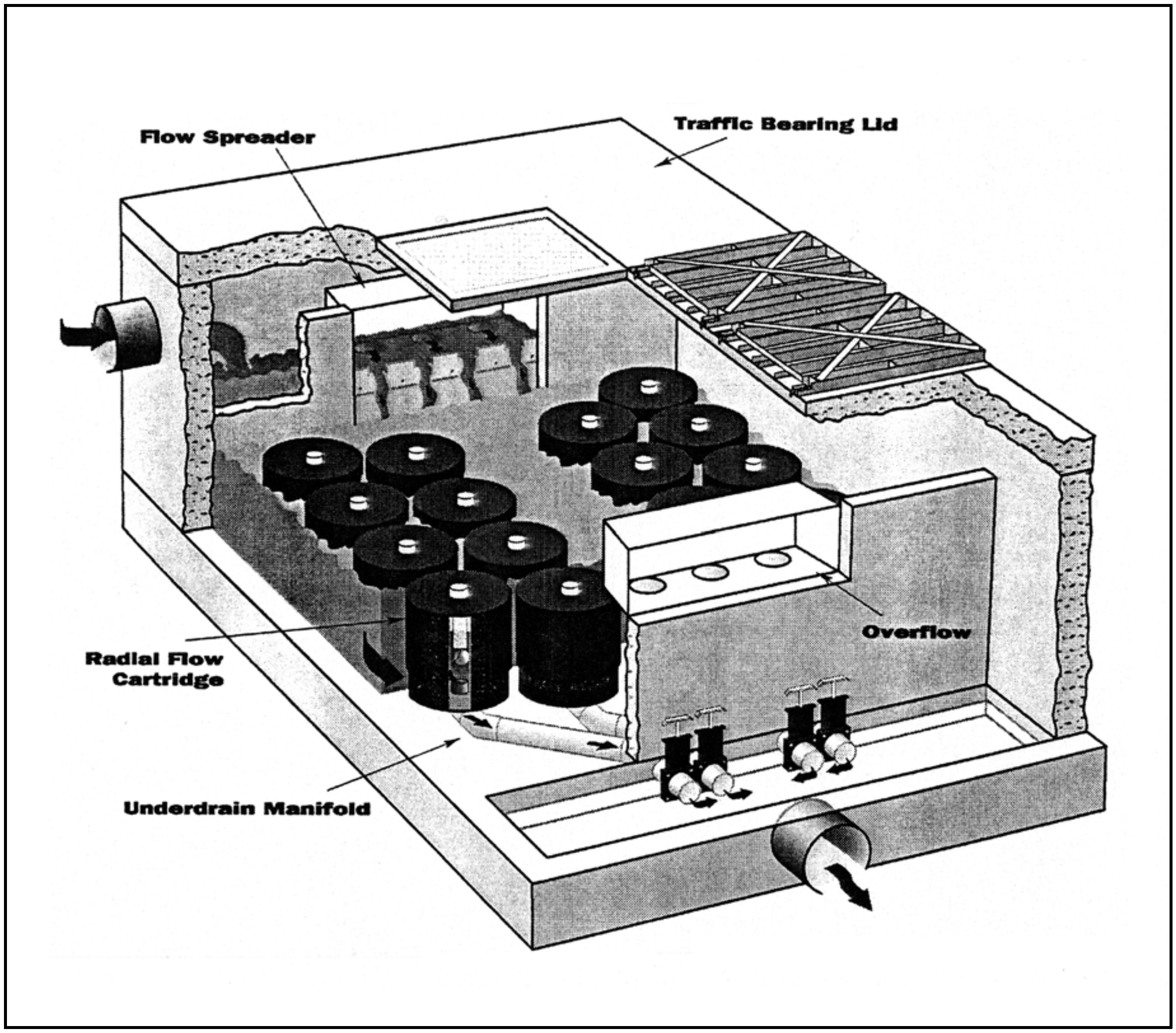
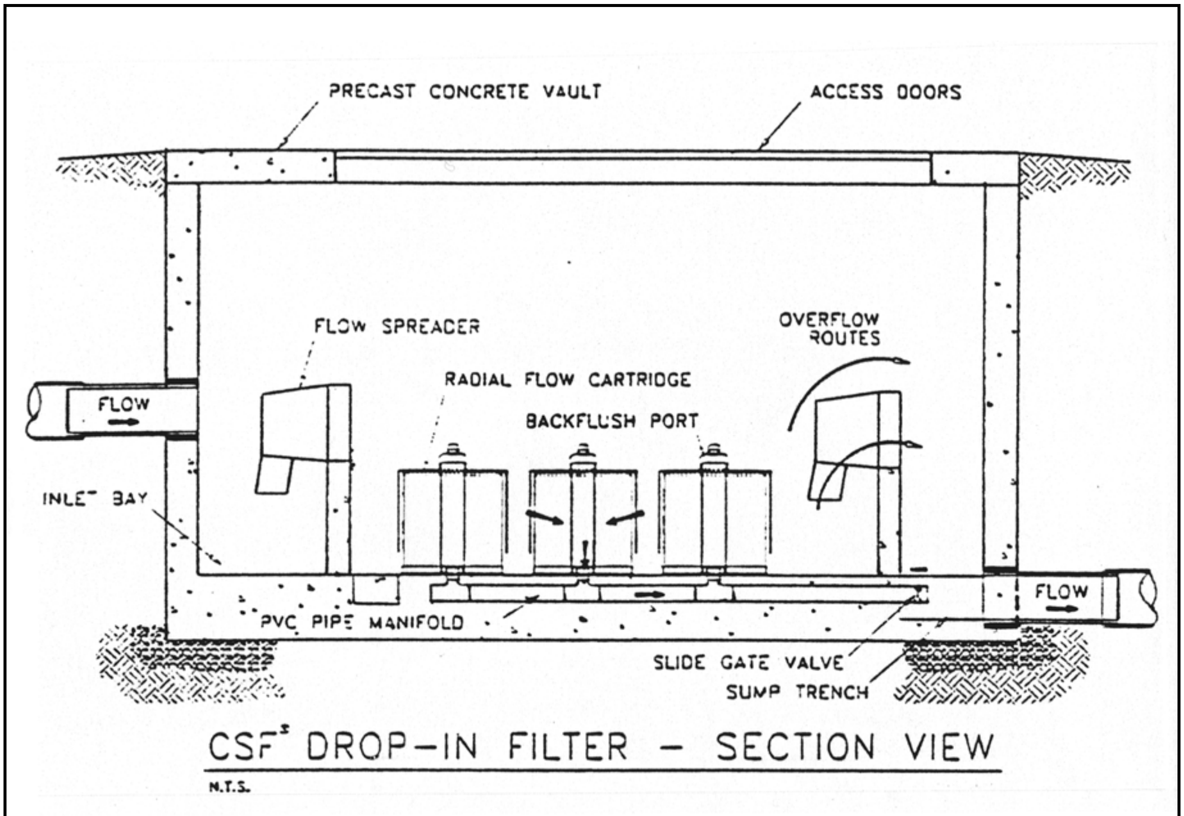


FIGURE 3.15-9
StormFilter Drop-In Filter



MINIMUM STANDARD 3.15F

BAYSAVER

Description

The Bay Saver system is comprised of three main components: the Primary Separation Manhole, the Secondary Storage Manhole, and the BaySaver Separator Unit. The primary and secondary manholes are both standard precast concrete drop structures. The BaySaver Separator Unit is constructed of high-density polyethylene (HDPE).

Stormwater runoff enters the BaySaver system through the primary separation manhole. As the water flows into the manhole, the larger sediments settle to the bottom of the tank. **Figure 3.15-10** shows a profile of the primary manhole. The structure has a minimum water level at the elevation of the BaySaver's surface skimming weir. This weir is a trapezoidal shaped weir with a bottom width ranging from 3" to 6", and a flow depth of 9" to 18", depending on the size unit as required by the contributing drainage area. As water flows into the manhole, the surface water flows over the weir and is diverted to the storage manhole. This water carries with it floating pollutants (oils, for example), debris, and fine sediment particles.

The BaySaver Separator Unit incorporates three flow paths that water can take through the system. The trapezoidal surface-skimming weir diverts first flush and low flows into the second manhole for the most efficient treatment. As the water level rises in the primary separation manhole, more water flows over the weir. The majority of oils and fine sediments are removed by this flow path.

During a more intense storm, the BaySaver unit will also allow water to flow through the inverted 90E elbow pipes. The elbow pipes draw water from the middle of the primary separation manhole, with the intakes approximately four feet below the surface, and discharge directly to the system outfall. The water pulled by the elbows is free of floating contaminants and has had time for suspended sediments to settle out. By discharging this water, the BaySaver can continue full treatment of the surface flow in the second manhole.

If the flow becomes too great for the system to effectively treat, the BaySaver bypasses the treatment stages, conveying water directly from inlet to outlet. Elongated openings in the crown of the elbow pipes serve as pressure equalizers, significantly reducing flow through the submerged inlets of the elbow pipes during bypass. This reduction minimizes the resuspension and discharge of trapped contaminants from the primary manhole. Bypass flows also prevent water from flushing through the storage manhole, providing more protection against the risk of resuspension of fines and oils.

There are no moving parts and no external power requirements for the BaySaver.

Overflow - Large storm bypass is accomplished first by the two 90E inverted elbow pipes, and second by overflowing the top plate over the weir (set approximately at ½ the diameter of the separator unit).

Hydraulics - The separator unit and associated overflow pipes are sized according to the drainage area being served. The system should operate without creating a back water condition in the upstream drainage system.

Planning Considerations

The BaySaver primary and secondary manholes are precast and come in three sizes depending on drainage area size. The system can be installed on an existing system (as a retro fit) or on a new system where water quality enhancement is required.

Target Pollutants - The BaySaver system is designed to capture sediment, total suspended solids (TSS) trash, organic material, and floatable oil and grease. In addition, many other urban pollutants which absorb to sediments and particles can also be trapped by the structure.

Design Criteria

The design criteria for the BaySaver should be obtained from the manufacturer. All designs should be reviewed by the manufacturer to insure that the system is appropriately designed and sized.

Maintenance and Construction

It is generally recommended that the system be maintained (full pump-out) once per year. This frequency may have to be adjusted to a shorter interval once loading rates are determined. Regular inspections will help determine the required frequency of cleaning. More frequent inspections are appropriate where oil spills occur regularly or a large volume of trash and debris are expected.

Contact:

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Phone: (301) 829-6119

FIGURE 3.15-10
BaySaver Primary Separation Manhole

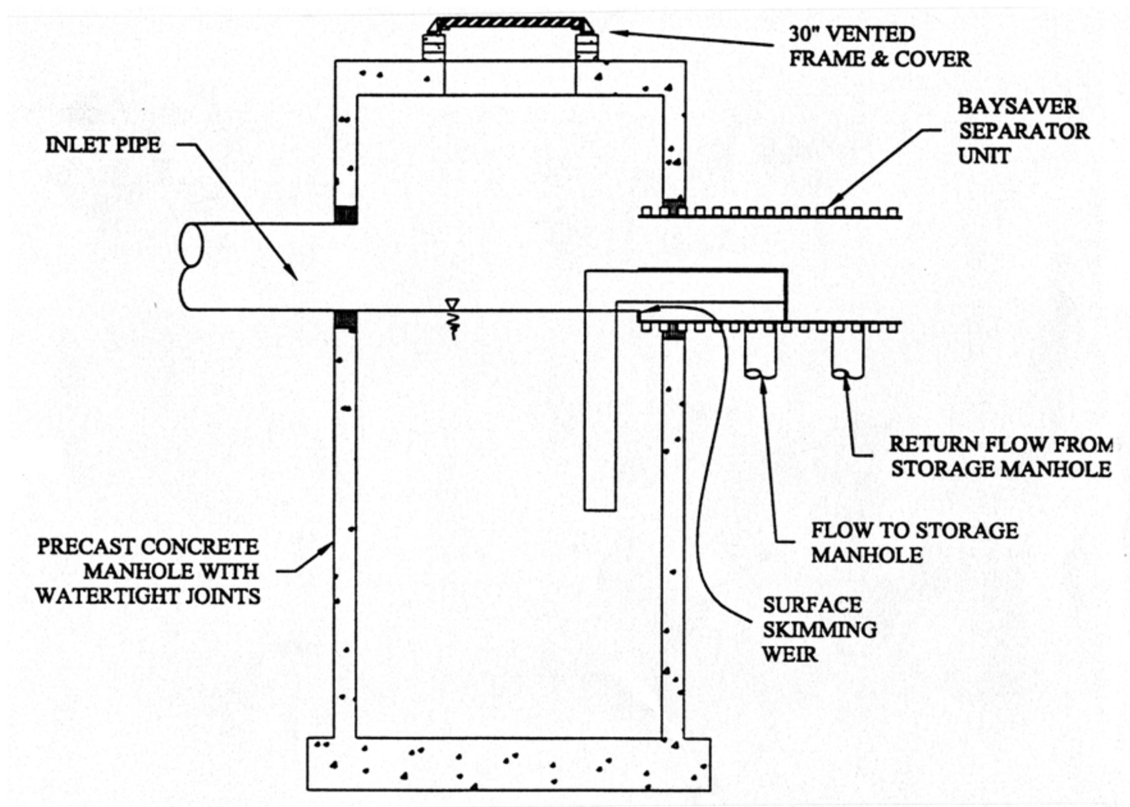
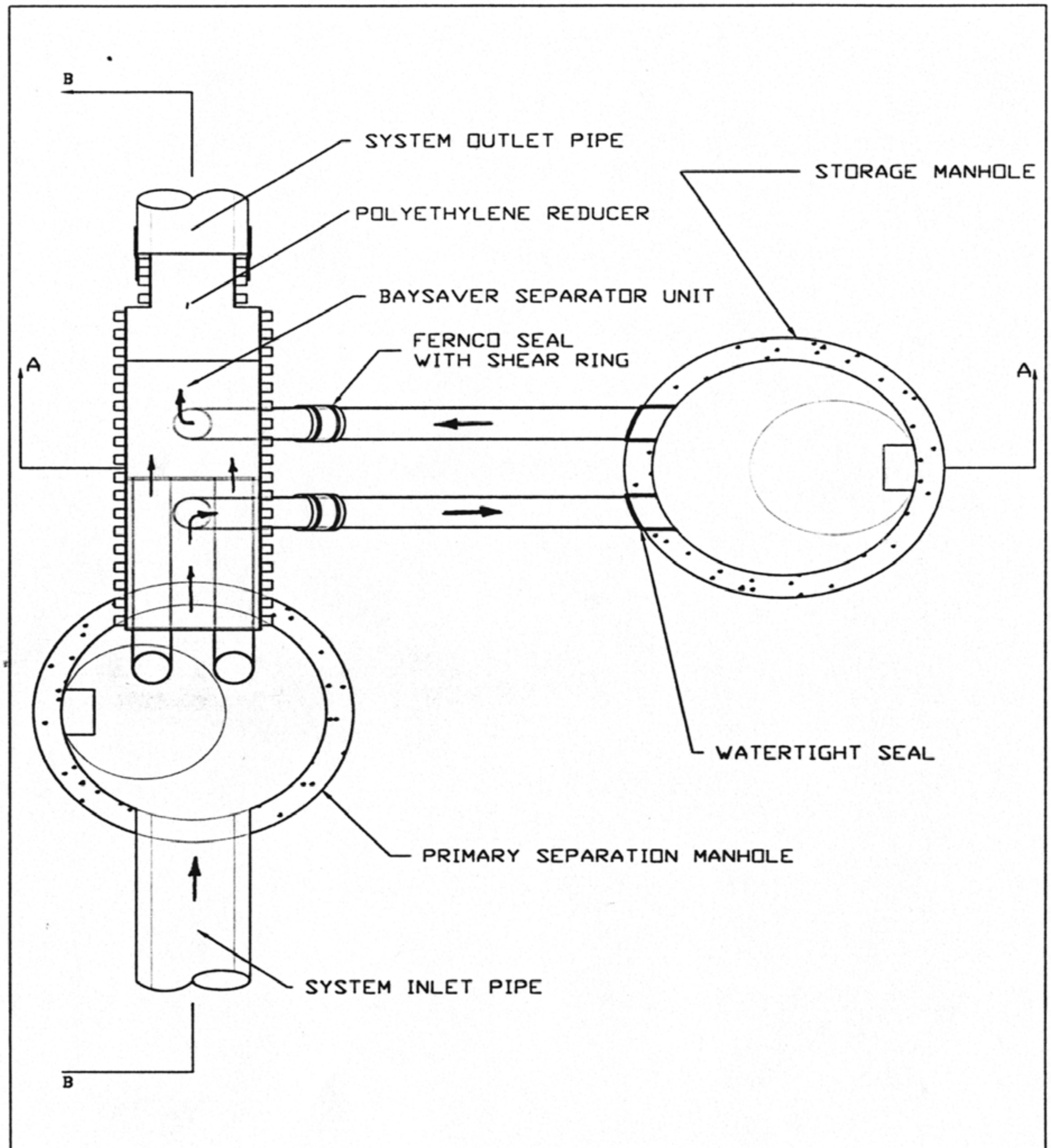


FIGURE 3.15-11
BaySaver Plan View



Plan View

FIGURE 3.15-12
BaySaver Section A-A

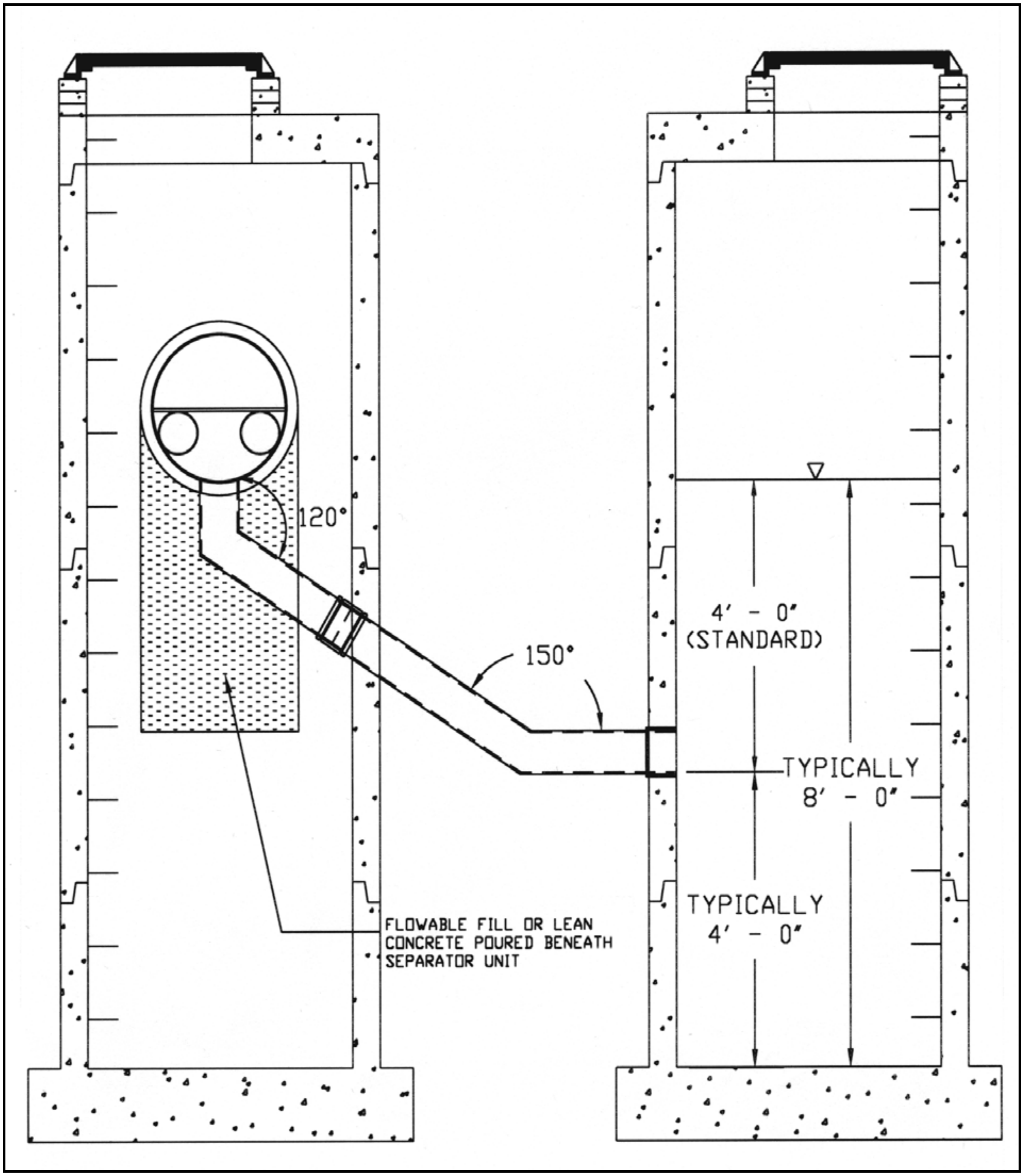
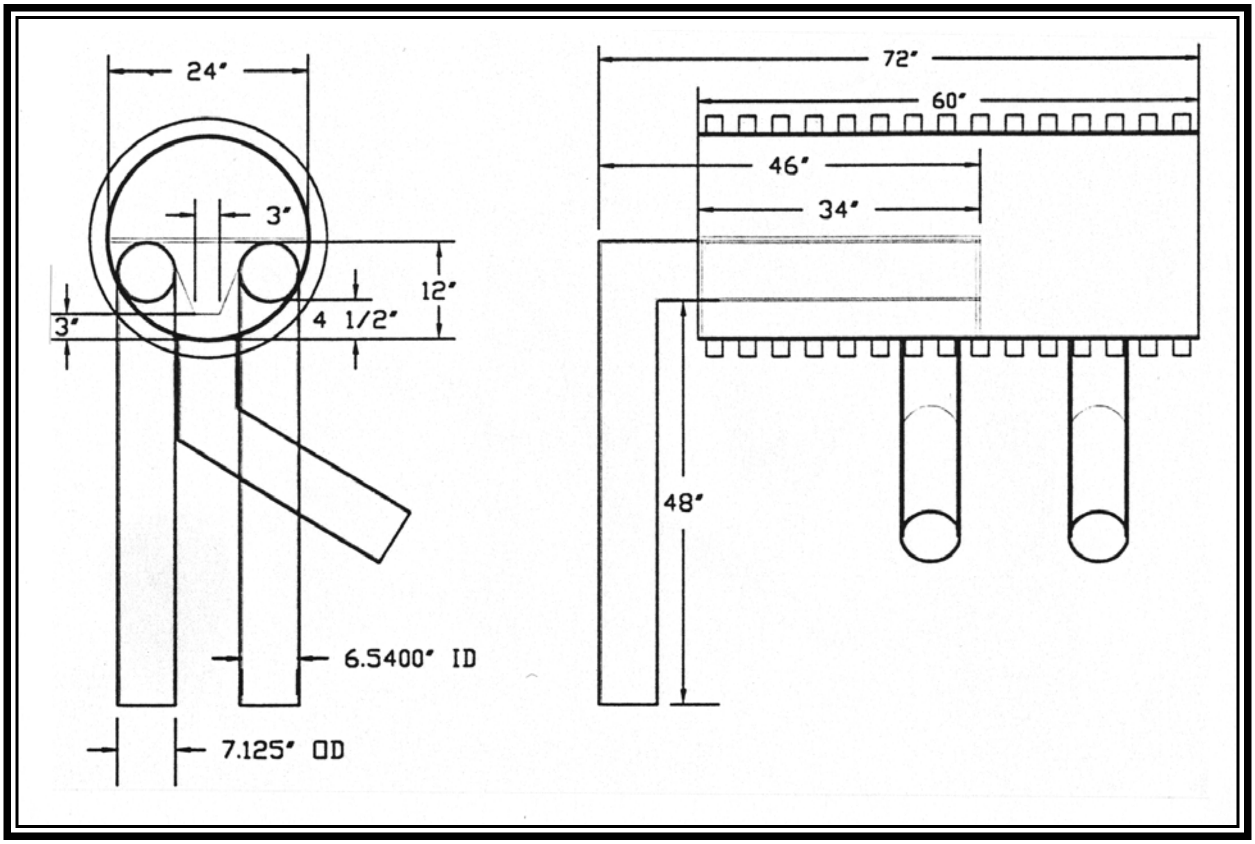


FIGURE 3.15-13
BaySaver 1K Separator Unit



Manufactured BMP Systems. Manufactured systems can be selected to address specific pollutant sources. This trench drain surrounds fuel handling area of a service station to direct any spills or otheridentified petroleum based contaminants to a manufactured system designed specifically for fuel or hydrocarbon containment. Note: fuel area is under cover which serves to limit the design flow entering the system.